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ABSTRACT

Research on science education in the Caribbean which has been completed and published between 1970-1987 in the form of doctoral or masters theses, published papers, conference/seminar papers, and university-based mimeograph research material was examined, synthesized, and organized around the following themes: (1) agricultural education; (2) assessment in science education; (3) cognitive development/concept attainment; (4) curriculum development/implementation/evaluation; (5) environmental education; (6) science achievement/orientation; (7) science attitudes; (8) nutrition/health education; (9) science education/teaching; (10) science teacher education; and (11) scientific literacy. Over 300 papers from 17 Caribbean countries were reviewed and discussed in terms of implications and future directions. A listing of research which is currently in progress, the personnel engaged in such research, statistics of school populations, and science curricula are provided. (TW)

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SUMMARY OF SCIENCE EDUCATION RESEARCH IN THE CARIBBEAN 1970 - 1987

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Introduction

In developed countries the major focus of educational research has been the improvement of teaching and learning. Until recently, the Caribbean could have been accused of force-fitting the results found in developed countries into our school setting (Miller 1981). Recently, decision makers are urging far greater attention to the composition and quality of science education. Educators in Caribbean countries are also voicing concern about the expansion and improvement of science education in schools. This concern poses a great challenge to researchers in science education since they are the ones to whom we must ultimately turn for answers to some recurring problems - How do we make science interesting and relevant? How can we improve the quality of science teaching? How can we raise the level of scientific literacy? How many of these questions have already been answered by research conducted in or about the Caribbean?

Purpose of Study

The purpose of this study was to determine and describe the nature and focus of science education research in 17 Caribbean countries during the period 1970-1987, to list research in progress and to lend direction to future research. A bibliography of research in eleven areas is also provided.

Procedure

In order to explore the nature and focus of science education research, the author gathered information from the following sources: science education researchers in and out of the Caribbean, Ministry of Education officials in all the islands, international and regional research organizations, The University of the West Indies Library and personnel, bibliographies, indexes, databases and international and regional journals.

Sample

The countries sampled included - Antigua, Bahamas, Barbados, Belize, Costa Rica, Cuba, Dominica, Guyana, Haiti, Montserrat, Puerto Rico, St Kitts/Nevis, St Lucia, St Vincent, Trinidad and Tobago, and the US Virgin Islands. Publications which dealt with the overall Caribbean were also consulted.

Although this paper provides a numerical list of research completed in Jamaica, the actual research is not analyzed since it has already been adequately treated by Glasgow (1987).

Results

Research in Science Education in the Caribbean completed and published between 1970-1987 in the form of doctoral or masters theses, higher diplomas, published papers, conference/seminar papers and university based mimeograph research material was examined, synthesized and organized around eleven themes. Tables I and II give an indication of the nature of the surveyed research as it relates to the entire Caribbean, and to individual countries and sources of publication/dissemination. Table III shows the research which is currently in progress.

To describe the research, each theme is treated separately and described in terms of nature and focus of research, findings, implications and future directions. A summary conclusion and a bibliography completes this report.

Agricultural Education

Publications in this area included:

1. Agricultural education programmes in schools : facilities, teacher training, methodology, student ability and attitude, readability of textbooks, assessment of the curriculum and its effectiveness and examples of successful programmes.
2. Agricultural education programmes at post-secondary level : curriculum development, assessment of the role and impact of these programmes on the community, and strategies for co-operation between teaching institutions.

The available experimental research indicates that the texts used at secondary level are inappropriate for the reading level of some 50% of those sampled; (Moonsie-Shageer 1986) there is a mismatch between student ability and Caribbean Examination Council (CXC) syllabus objective (Rajkumar-White 1986) and there is a lack of motivation for students to follow a career in agriculture in spite of their positive attitude to agricultural education. (Maraj 1986) The improvement in the curriculum at all levels, teaching techniques that reflect a more practical field related orientation, teacher education and facilities that prepare an individual for employment in agriculture are areas that continue to need further development and research. One of the problems noted here was the underutilization of the

research capabilities that exist in the English-speaking Caribbean, there is a need to maximise resources through linkages and collaboration among various agricultural institutions in the Caribbean and to increase the linkages between research and extension.

The economy of the Caribbean is to a large extent dependant on the agricultural sector. It is therefore necessary to provide adequate agriculture education from primary to tertiary level if we are to motivate our people to pursue careers in agriculture. The necessary research needs to be undertaken to lend support and direction to all those involved in agriculture education.

Assessment in Science Education

There has been little research in this important area. The fourteen publications included test development and validation of innovative aspects of the Caribbean Examination Council (CXC) integrated science and maths syllabus and assessment of practical work in science.

Assessment in Science Education is clearly an area which needs to be examined in greater detail. Many teachers both elementary and secondary place great value in science as a practical subject, yet the bulk of science assessment is traditionally non-practical. Despite the strong convictions about the importance of practical work, research suggests that laboratory activities are used less frequently

in schools in developing countries than science educators would desire (Bryce 1985). Furthermore there were some major mismatches between teacher aims and students perceptions. Do these findings hold true for the Caribbean which has in its Caribbean Examination Council (CXC) examination introduced a novel way of assessment? At elementary level does the content type exam adequately test the process based type teaching and learning that is now prevalent? Are teachers using adequate in-house assessment procedures? Are they testing what they teach? These are some of the areas that need to be addressed both at the national and regional levels.

Cognitive Development/Attainment

Publications could be sub-divided into the following categories:

1. Assessment of levels of cognitive development at pre-school, primary and secondary level.
2. Cogntive development and curriculum cognitive demands;
3. Study of cognitive structures and metacognitive behaviour of successful and less successful students;
4. The acquisition of science concepts at pre-school, primary, secondary and tertiary level;
5. Cross-cultural studies of cognitive development and concept learning.

Several findings and implications have emerged from the research. It has been impossible to classify students according to the developmental levels postulated by Piaget. At elementary levels, females attained a higher level than males, children of university graduates performed better than those of non-graduates, and there were some differences in cognitive development attainment among students in the islands studied. This points to the need to look at the effect of this difference on students performance in the common regional examination.

Research carried out between 1970-1979 revealed that the science curricula were making excessive demands on the majority of students. (Adey 1981) Does this mismatch still hold true with the introduction of the Caribbean Examination Council (CXC) general and basic proficiency exam? Research indicates that successful students were better able to embellish and encode knowledge than less successful students after being subjected to training in elaborative activities. There is a need to study this strategy with a larger sample and to devise means of incorporating the results into teacher education courses. (Durgadeen 1987) The acquisition of the concepts of length, volume, animism and dynamism, among others, have been researched and some attempt made to incorporate the findings into curriculum development. (Fraser-Abder 1983) Much more research in this area is needed.

Science education researchers believe that it is important to have replication of research in order to identify those findings which have stability and consequently the generalizability needed to build a knowledge base in the Caribbean. To achieve this it is recommended that science education researchers engage in cooperative research in a variety of settings to test the hypotheses and the practical applications of the theories generated both here and elsewhere. This research is needed not only in the area of cognitive development but in all researchable areas. The International Consortium for Concept Learning Research formed in 1985 and comprised of members from the Caribbean, Latin America, USA, Canada and the UK has as its main aim the replication of research in all the countries included. The current research topic of the Consortium is the use of technology to facilitate the transition of young children from concrete understanding of concepts to abstract thought.

Curriculum Development, Implementation and Evaluation

Publications in this area have been very numerous and include:

1. Development, implementation and evaluation of primary and secondary science curricula;
2. A teacher training and curriculum development model;

3. Problems in curriculum development, implementation and evaluation;
4. Curriculum content;
5. Overview of science curriculum;
6. Influences on the practice of science curriculum.

Most of the publications give an account of the status of curriculum development. One finds that at elementary level several process-based curricula have been developed. At the secondary level many publications provide an overview of the Caribbean Examination Council (CXC) syllabus. Insufficient research, however, has been done on the effects of the new science curricula on student performance, and on teacher attitudes. One of the publications discusses a successful model for teacher involvement in curriculum development and implementation in one country. Will this model be successful in other countries? One study (Eck 1986) found that teaching science yields positive results when the curriculum relates to the child's environment and the method of teaching is practical. Does this also apply in the other countries. Researchers in the area of science curriculum development, implementation and evaluation need to pool resources since in mosts of the islands students are being prepared for a common final examination.

Environental Education

The nine publications in this area focussed on curriculum development and environental awareness. In a group of islands where the inhabitants exhibit little or no awareness of the environment and continue to erode their scarce environmental resources, it is imperative that science education researchers investigate and develop strategies for the development of positive environmental attitudes, awareness and appreciation. More research is urgently needed in this area.

Science Achievement/Orientation

Publications in this area included:

1. Student performance and factors affecting achievement at elementary, secondary and tertiary levels.
2. Factors associated with science orientation.
3. The effect of certain teaching strategies on achievement.

Flemming and Malone (1983) in their meta-analysis found that a students' general ability, language ability and mathematical ability have the strongest positive relationship to performance in science achievement. Several findings and implications have emerged from the publications. Caribbean research in some islands indicate that socio-economic status, learning style, school type and

gender have the strongest positive relationship to performance on science achievement. Does this also apply to the other islands? What other factors affect science achievement? Answers to these questions should provide the researchers with the tools for helping the teacher structure his/her instruction to produce maximum science achievement.

Wilson (1983), in a meta-analysis of research on science achievement, found that achievement in science seems more highly related to interest in science than it is to psychologically scaled attitude. In the Caribbean, most science curricula have included objectives that students should have positive attitudes toward science. (Wilson 1983) claims that a better objective might be that students have an attitude toward science. Baumrind's theory suggests that positive affect will follow success in science achievement. Perhaps science curriculum should concentrate on achievement and let the affect follow without curricular emphasis. Whether this suggestion holds true for the Caribbean is a highly researchable and useful question.

Wise and Okey (1983) report that the effective science classroom appears to be one in which students are kept aware of instructional objectives and receive feedback on their progress toward these objectives. Would this be an effective science teaching strategy in the Caribbean? It is currently in use in some islands? These are some of the

researchable questions which emerge from the regional and international publications.

Science Attitudes

Insufficent emphasis has been placed on this significant area of research. There were only seven publications in this area and they dealt with attitudes to science (including integrated science) and science teaching, and the development of a model to effect attitude change. In one country elementary and secondary teachers were found to have a positive attitude to science and science teaching and no gender differences were noted, while in another males were found to have a more positive attitude than females, and the teachers science background significantly affected their attitude. None of the studies looked at the attitude of male and female students to science. Schibeci's (1984) update of attitudes to science concluded that males display a considerably more favourable attitude towards science. Is this also true of the Caribbean population? If it is what can we do to positively affect the attitude of girls to science?

Several areas need to be investigated, including:-

1. Relationship between attitude and personality: Internationally, relatively few studies have been conducted in this area (Schibeci 1984). Those that

have been, suggest that personality variables may have important influences on student attitude.

2. Relationship between attitudes and gender: This needs to be researched both at the level of the teacher and of the students. The results could be of significant importance to curriculum implementation and the future role played by males and females in science.
3. Relationship between structured variables (e.g. grade level, socio-economic status, religion, peer group environment) and attitude.

It appears that student attitude decline with increasing grade level. (Schibeci 1984) There is a need to examine if this is really so and if the decline in science attitude is more rapid than the decline in attitudes toward school and to other subject areas. The general pattern which emerges from studies of the other structured variables is that these do not appear to influence attitude in a substantial, direct way. Does this apply to the Caribbean situation?

4. Relationship between school variables and attitudes:

An important area to study here is that of the effect of science classroom climate on attitude of both boys and girls.

Attention needs to be paid to the way in which cognitive and affective variable interact in science education.

There is also a need to give more consideration to which attitudinal objectives ought to be included in new or revised science curricula.

Nutrition/Health Education

Publications deal with:

1. Status, development and implementation of nutrition/health education programmes.
2. Nutrition/health education curriculum development, implementation and evaluation.
3. The teaching of nutrition and health.
4. Teaching strategies.

The publications presented trends and progress in the field of nutrition and health education and pointed to the need to open up the channels for more effective communication between the practitioners and the community.

They suggested an innovative way of communicating health messages through music, dance and drama. (Standard & Minnot 1983)

One research paper concluded that nutrition education provided to fathers diffused to mothers and influenced food avoidance and feeding practices. (Webb 1985) Is this also true of the other islands?

Further research in the area of Nutrition and Health education need to be done at primary, secondary and tertiary level and also with the out-of-school population.

Science Education/Teaching

Publications covered

1. Teaching strategies
2. Factors affecting science education
3. Problems in science teaching
4. Role of science educators
5. Overview of science education/teaching
6. Motivation
7. Role of the teacher in science education
8. Rationale for integrated science
9. Aims and practice of science education
10. Directions in science education

Studies show that socio-historical, contextual and internal factors are all instrumental in shaping the nature and structure of classroom transactions.

Most of the studies relate to the status of science education/teaching in specific countries. Empirical studies aimed at improving science education/teaching are few. Several projects on the teaching of science are in operation in the Caribbean. A global assessment of science education/teaching in all the islands would be of interest from the point of view of current operation and possible co-ordination of efforts and of planning for future action in the area.

Relationships between school climate and teaching style, age and ability of student and classroom practice also need to be researched.

Science Teacher Education

Publications included:

1. Teacher training - strategies.
2. Role of supervisors, coordinators and teachers.
3. Curriculum development, implementation and evaluation.
4. Implication of primary and secondary science for teacher's colleges curriculum.
5. Desirable teacher behaviours.
6. Teacher perception of school curriculum.

Most of the publications discuss the status of science teacher education and point to the need for a well-thought-out program of in-service education comprising workshops, seminars etc., for teachers at the primary level. There is a need to extend what is currently being done by Caribbean Examination Council (CXC) to include more secondary teachers and to upgrade and expand secondary teachers courses offered by UWI.

Scientific Literacy

The following suggestions arise from the few publications found in this area:

1. The need for the development of an out of school science programme consisting of well organised science fairs, mobile/or fixed science and technology museums and science learning centres to help uplift the standard of scientific literacy in the Caribbean. (Fraser-Abder 1985)
2. The need to pay greater attention to the social customs and beliefs of the community and how these affect children's ability to learn and conform to conventional science in schools. (George 1986)

Conclusion

Although the study has provided some tentative answers to some of the questions raised in the introduction, it points to the need for further research in all the eleven areas reviewed and the addition of other research areas including the areas of science and technology, utilization and effectiveness of computers in science education, and cross-cultural research involving not only Caribbean islands but other developing and developed countries. A need for a research consortium or network to facilitate, consolidate and direct research has been identified. Many of the papers have direct relevance for practising teachers as well as for the examination systems. However, there is a paucity of research addressing the very important issue of the injection of the technological dimension in science

education. The study attempted to identify the strengths and weaknesses of the Caribbean Science Education Research system, to show where we are and to lend direction to plans for where we want to go.

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TABLE 1

NATURE OF SURVEYED RESEARCH COMPLETED IN THE CARIBBEAN BETWEEN 1970 - 1987

Research Area	Source of Publication/Dissemination						
	Doctoral Dissertation	Masters Thesis	Higher Diploma	Journals	Reports/Mimeo/ Bibliography	Conference	Total
Agricultural Education	6	2	4	2	1	9	24
Assessment in Science Education	2	0	0	4	4	5	15
Cognitive Development	5	3	3	11	5	8	35
Curriculum Development	3	4	0	20	27	10	64
Environmental Education	1	1	0	4	4	7	17
Science Achievement	12	5	2	15	10	6	50
Science Attitude	1	1	0	7	2	3	14
Nutrition/Health Education	5	1	0	10	11	1	28
Science Education/Teaching	3	2	0	26	12	8	51
Science Teacher Education	7	2	0	2	5	8	24
Science Literacy	1	1	0	3	3	5	13
	46	22	9	104	84	69	335

TABLE 2

NATURE OF SURVEYED RESEARCH COMPLETED IN INDIVIDUAL ISLANDS

Islands	Research Areas											Total
	Ag. Ed.	Assim. Ed.	Cog. Dev.	Curr. Dev.	Envir. Ed.	Sc. Ach.	Sc. Attit.	Nut. H. Ed.	Sc. Ed./T.	Sc. T. Ed.	Sc. Lit.	
Antigua	0	0	0	1	0	0	0	0	0	0	0	1
Bahamas	0	0	0	1	0	0	0	0	0	1	0	2
Barbados	0	0	1	1	1	3	0	0	1	1	0	8
Belize	1	0	1	4	0	0	0	1	0	0	0	7
Caribbean	7	6	11	29	5	7	1	12	25	11	5	119
Costa Rica	1	3	0	0	1	1	1	0	1	0	0	8
Cuba	0	0	1	0	0	0	0	0	4	1	0	6
Dominica	0	0	1	2	0	1	0	0	1	0	0	5
Guyana	2	1	2	2	0	0	0	0	0	1	0	8
Haiti	0	0	0	0	0	0	0	5	0	0	0	5
Jamaica	2	3	3	10	8	18	7	7	10	3	5	76
Montserrat	0	0	0	0	0	1	0	0	0	0	0	1
Puerto Rico	2	2	1	2	1	7	1	1	2	3	0	22
St. Kitts/Nevis	0	0	0	0	0	1	0	0	0	0	0	1
St. Lucia	0	0	0	1	0	0	0	0	0	0	0	1
St. Vincent	0	0	1	0	0	0	0	0	1	0	0	2
Trinidad & Tobago	9	0	13	10	1	11	4	2	6	3	3	62
U.S. Virgin Island	0	0	0	1	0	0	0	0	0	0	0	1
	24	15	35	64	17	50	14	28	51	24	13	335

TABLE 3

RESEARCH IN PROGRESS

	Topics	No. of Projects in Progress
1.	Agricultural Education	3
2.	Assessment in Science Education	10
3.	Cognitive Development	8
4.	Curriculum Development	10
5.	Environmental Education	2
6.	Science Achievement	5
7	Science Attitude	8
8.	Nutrition/Health Education	0
9.	Science Education/Teaching	9
10.	Science Teacher/Education	3
11.	Science Literacy	8
New Areas		
12.	Computer in Education	5
13.	Science & Technology	2
14.	Cross-Cultural Research	4

AGRICULTURAL EDUCATION

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